PAYLOAD FLIGHT HAZARD REPORT				a. NO:	AMS-02-F17
b. PAYLOAD	Alpha Magnetic Spectrometer-02 (AMS-02)			c. PHASE:	II
d. SUBSYSTEM:	Avionics	e. HAZARD GROUP:	Injury, Damage to critical systems	f. DATE:	March 31, 2006
g. HAZARD TITLE:	Electrical Power Distribution Damage			i. HAZARD CATEGORY:	CATASTROPHIC **X** CRITICAL
h. APPLICABLE SAFETY REQUIREMENTS:	NSTS 1700.7B and ISS Addendum: 201.3, 207, 213.1				
j. DESCRIPTION OF HAZARD:	Damage to electrical power distribution circuitry can lead to damage to shuttle and ISS wiring, loss of critical circuitry and loss of power source.				
k. CAUSES *(list)*	1. Short circuit or load failures induce over-current condition in vehicle wiring. 2. Cross strapping of power sources damages vehicle circuitry.				

o. APPROVAL	PAYLOAD ORGANIZATION	SSP/ISS
PHASE I		
PHASE II		
PHASE III		

PAYLOAD FLIGHT HAZARD REPORT		a. NO:	AMS-02-F17
b. PAYLOAD	Alpha Magnetic Spectrometer-02 (AMS-02)	c. PHASE:	II
l. HAZARD CONTROL (CONTROL), m. SAFETY VERIFICATION METHODS (SVM), n. STATUS OF VERIFICATIONS (STATUS)			OPS CONTROL
1. CAUSE: Short circuit or load failures induce over-current condition in vehicle wiring.			
1.1 CONTROL: Wire gauge and insulation have been selected to meet NSTS 1700.7B, "Safety Policy and Requirements For Payloads Using the Space Transportation System", NSTS 1700.7B ISS Addendum, "Safety Policy and Requirements For Payloads Using the International Space Station", and NASA Technical Memorandum #TM 102179, "Selection of Wires and Circuit Protection Devices for NSTS Orbiter Vehicle Payload Electrical Circuits" including proper wire bundle derating. 1.1.1 SVM: Review of Design 1.1.2 SVM: Inspection of As Built Design 1.1.1 STATUS: Open 1.1.2 STATUS: Open			
1.2 CONTROL: Circuit protection devices are sized to protect wiring and systems to meet NSTS 1700.7B, "Safety Policy and Requirements For Payloads Using the Space Transportation System", NSTS 1700.7B ISS Addendum, "Safety Policy and Requirements For Payloads Using the International Space Station", and NASA Technical Memorandum #TM 102179, "Selection of Wires and Circuit Protection Devices for NSTS Orbiter Vehicle Payload Electrical Circuits" 1.2.1 SVM: Review of Design 1.2.2 SVM: Inspection of as built design 1.2.1 STATUS: Open 1.2.2 STATUS: Open			
1.3 CONTROL: Wiring and connectors coming from the ISS, Orbiter APCU, T-0 and PVGF continue the wire rating of the supplying source to the location of circuit protection devices within the Power Distribution System and the Cryomagnet Avionics Box. 1.3.1 SVM: Review of design 1.3.2 SVM: Inspection of as build design 1.3.1 STATUS: Open			

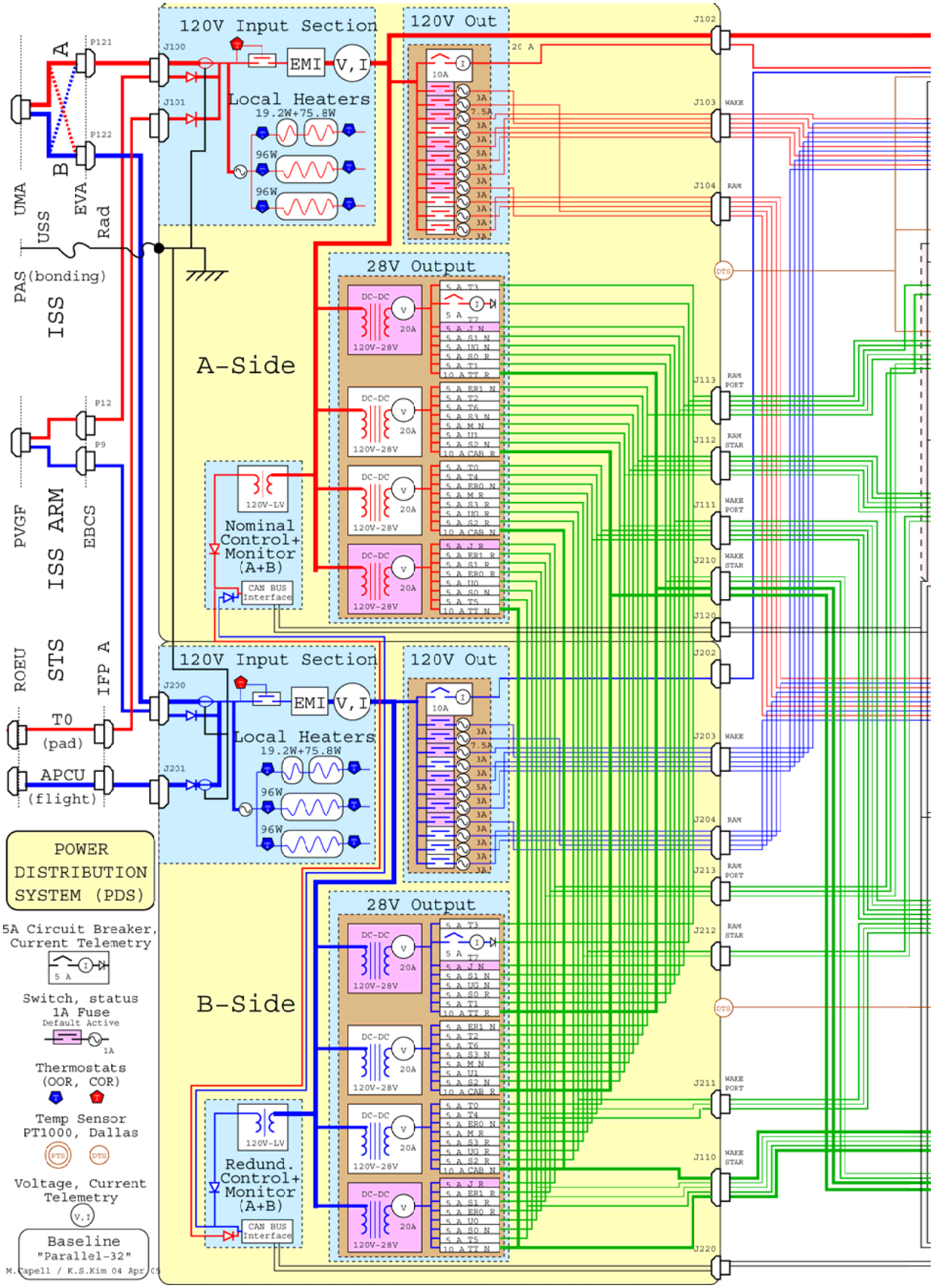
PAYLOAD FLIGHT HAZARD REPORT	a. NO: AMS-02-F17
b. PAYLOAD Alpha Magnetic Spectrometer-02 (AMS-02)	c. PHASE: II

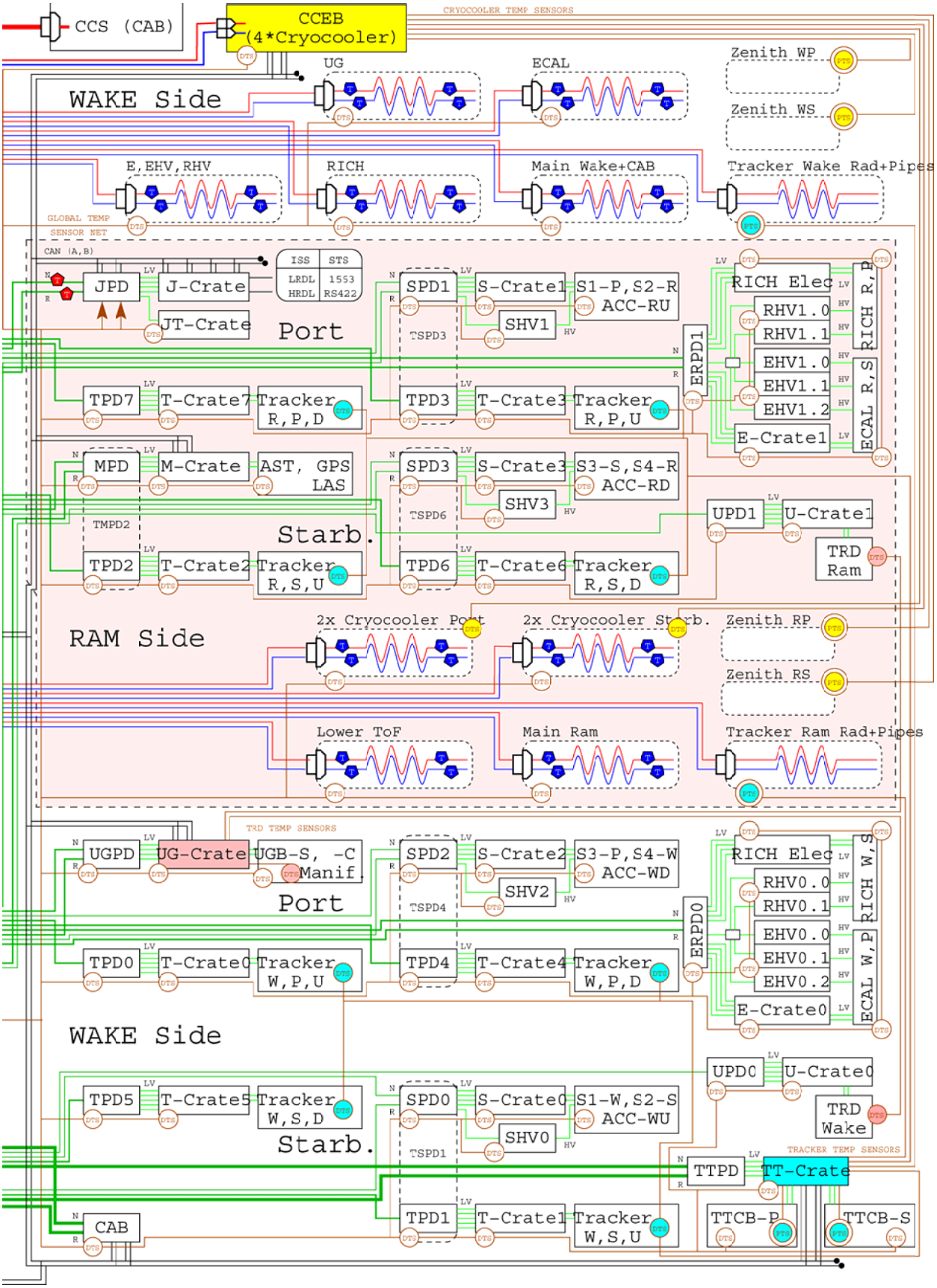
1.3.2 STATUS: Open	
2. CAUSE: Cross strapping of power sources damages vehicle circuitry.	
2.1 CONTROL: Diodes in the power supply circuit from the ROEU and from the ISS SSRMS preclude power from the ISS and the SSRMS from being present at the ROEU connector. Diodes also preclude ISS UMA supplied power from being present at the SSRMS grapple fixture connector. 2.1.1 SVM: Review of design for proper use of diode protection 2.1.2 SVM: Inspection of design to assure proper installation of diode protection 2.1.3 SVM: Testing of AMS-02 power interfaces to assure that diode protection is functioning. 2.1.1 STATUS: Open 2.1.2 STATUS: Open 2.1.3 STATUS: Open	
2.2 CONTROL: The UPS can not feed power directly to the vehicle power supply. The only interface to vehicle supplied power from the UPS is through the battery management system (BMS) and through Quench Detection System in the Cryomagnet Avionics Box. 2.2.1 SVM: Review of Design to assure no interconnection between UPS power circuitry and Vehicle power circuitry. 2.2.2 SVM: Testing of AMS-02 Flight interfaces to establish that no UPS power is present. 2.2.1 STATUS: Open 2.2.2 STATUS: Open	
2.3 CONTROL: The two ISS power feeds are maintained within separate circuitry within the AMS-02 and are not "combined" until after the 120VDC power has been processed through independent DC to DC converters. There is no nominal or component fault that will cause the two ISS power feeds to be interconnected. 2.3.1 SVM: Review of Design 2.3.2 SVM: Functional testing of AMS-02 for isolation between A and B buses at flight power interfaces. 2.3.1 STATUS: Open	

PAYLOAD FLIGHT HAZARD REPORT		a. NO:	AMS-02-F17
b. PAYLOAD	Alpha Magnetic Spectrometer-02 (AMS-02)	c. PHASE:	II
2.3.2 STATUS: Open			
Notes:			

ACRONYMS	
A – Amperes	ROEU – Remotely Operated Electrical Umbilical
ACC – Anticoincidence Counter	RP – Ram side port
AMS-02 – Alphamagnetic Spectrometer - 02	RS – Rams side starboard
APCU – Auxillary Power Control Unit	SFHe – Superfluid Helium
BMS – Battery Management System	SFHe – Superfluid Helium
CAB – Cryomagnet Avionics Box	SSRMS – Space Station Remote Manipulator System
CCEB – Cryocooler Electronics Box	Starb. – Starboard
CCS – Cyromagnet Current Source	SVM – Safety Verification Method
DC – Direct Current	TOF – Time of Flight
DC-DC – Direct Current to Direct Current (converter)	TRD – Transition Radiation Detector
DTS – Dallas Temperature Sensor	TTCB – TTCS Control Box
ECAL – Electromagnetic Calorimeter	TTCS – Tracker Thermal Control System
EMI – Electromagnetic Interference	UMA – Umbilical Mating/Mechanism Assembly
EVA – Extravehicular Activity	UPS – Uninterruptible Power Supply
HRDL – High Rate Data Link	USS – Unique Support Structure
LRDL – Low Rate Data Link	VC – Vacuum Case
Mainf – Manifold	VDC – Volts Direct Current
PAS – Payload Attach Site	W – Watt
PVGF – Power Video Grapple Fixture	WP – Wake side port
RICH – Ring Imaging Cherenkov (detector)	WS – Wake side starboard

DECODING Electronic Boxes and Nomenclature:	
FIRST Character(s)	Following Designator
E - ECAL	PD – Power Distribution
J – Main Data Computers (MDC) and Command & Data Handling interfaces	HV – High Voltage
JT – Trigger and central data acquisition	Crate – Electronics box or crate
M – Monitoring	
R – RICH	Numerical designators follow.
S – Time of Flight (TOF) and Anti-Coincidence Counter (ACC)	
T – Tracker	
TT – Tracker Thermal	
U – Transition Radiation Detector (TRD)	
UG – TRD Gas	


120V Input Section
120V Out
EMI
V, I
Local Heaters
19.2W+75.8W
96W
96W
28V Output
A-Side
B-Side
DC-DC
120V-28V
20A
120V-LV
Nominal Control+ Monitor (A+B)
Redund. Control+ Monitor (A+B)
CAN BUS Interface
P121
P122
P12
P9
J100
J101
J200
J201
J102
J103
J104
J110
J111
J112
J113
J120
J202
J203
J204
J210
J211
J212
J213
J220
WAKE
RAM
RAM PORT
RAM STAR
WAKE PORT
WAKE STAR
DTS
UMA
USS
EVA
Rad
B
A
PAS
(bonding)
ISS
PVGF
ISS ARM
EBCS
ROEU
STS
IFP A
T0
(pad)
APCU
(flight)
POWER DISTRIBUTION SYSTEM (PDS)
5A Circuit Breaker, Current Telemetry
Switch, status 1A Fuse
Default Active
Thermostats (OOR, COR)
Temp Sensor PT1000, Dallas
Voltage, Current Telemetry
Baseline
"Parallel-32"
M.Capell / K.S.Kim 04 Apr

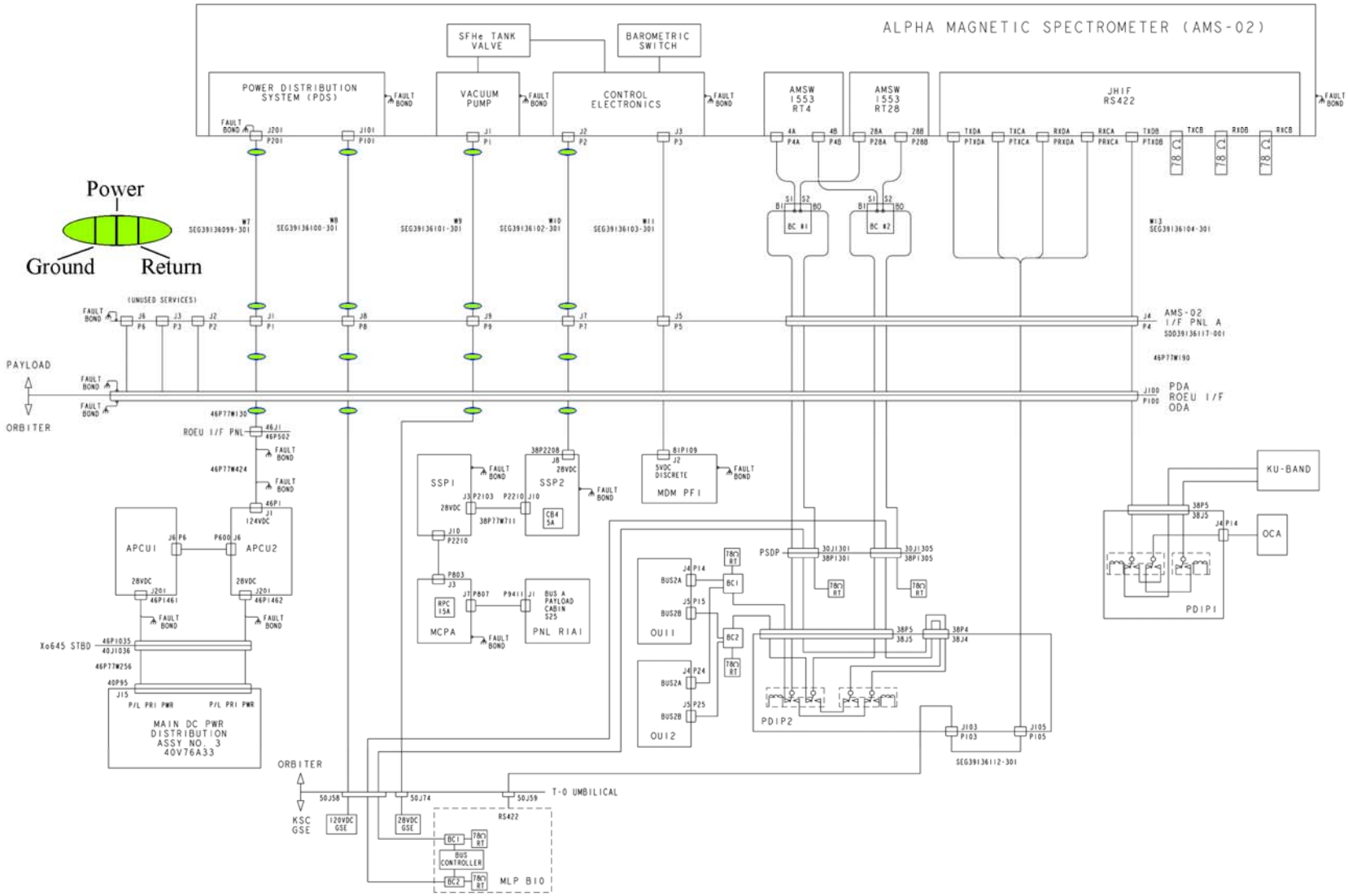

CCS (CAB)
CCEB
(4*Cryocooler)
CRYOCOOLER TEMP SENSORS
UG
ECAL
Zenith WP
Zenith WS
WAKE Side
E,EHV,RHV
RICH
Main Wake+CAB
Tracker Wake Rad+Pipes
GLOBAL TEMP SENSOR NET
CAN (A,B)
ISS
STS
LRDL
1553
HRDL
RS422
JPD
J-Crate
JT-Crate
Port
SPD1
S-Crate1
S1-P,S2-R
ACC-RU
SHV1
TSPD3
RICH Elec
RHV1.0
RHV1.1
EHV1.0
EHV1.1
EHV1.2
E-Crate1
RICH R,P
ECAL R,S
ERPD1
TPD7
T-Crate7
Tracker R,P,D
TPD3
T-Crate3
Tracker R,P,U
MPD
M-Crate
AST, GPS LAS
SPD3
S-Crate3
S3-S,S4-R
ACC-RD
SHV3
TSPD6
TMPD2
Starb.
UPD1
U-Crate1
TRD Ram
TPD2
T-Crate2
Tracker R,S,U
TPD6
T-Crate6
Tracker R,S,D
RAM Side
2x Cryocooler Port
2x Cryocooler Starb.
Zenith RP
Zenith RS
Lower ToF
Main Ram
Tracker Ram Rad+Pipes
TRD TEMP SENSORS
UGPD
UG-Crate
UGB-S, -C Manif.
SPD2
S-Crate2
S3-P,S4-W
ACC-WD
SHV2
TSPD4
RHV0.0
RHV0.1
EHV0.0
EHV0.1
EHV0.2
E-Crate0
RICH W,S
ECAL W,P
ERPD0
TPD0
T-Crate0
Tracker W,P,U
TPD4
T-Crate4
Tracker W,P,D
WAKE Side
UPD0
U-Crate0
TRD Wake
TPD5
T-Crate5
Tracker W,S,D
SPD0
S-Crate0
S1-W,S2-S
ACC-WU
SHV0
TSPD1
Starb.
TRACKER TEMP SENSORS
TTPD
TT-Crate
TTCB-P
TTCB-S
TPD1
T-Crate1
Tracker W,S,U
CAB

Vehicle Current Limitations and Circuit Protection

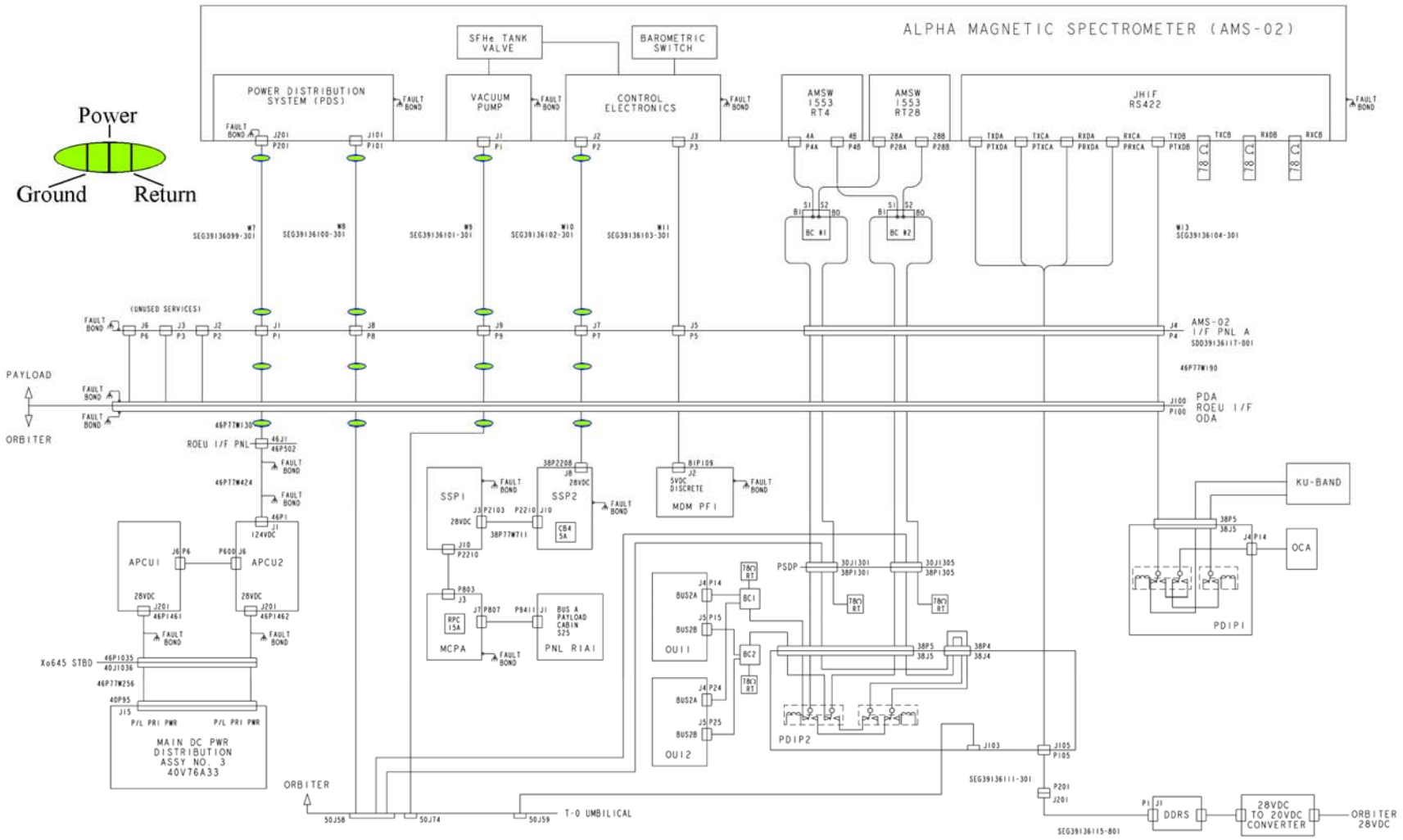
SOURCE	Wire/Cabling	Maximum Current Provided Nominally	Lowest Current Limitation Level	Voltage
STS T0 Power	4 x AWG 12	14.7 A	22A	120 V
STS APCU	3 x AWG 8	14.7 A	22 A	120 V
ITS S3 PAS 2	3 x AWG 8	25 A	27.5 A	120 V
PVGF	4 x AWG 12	15 A	27.5 A	120 V
STS SSP	20 AWG	5 A (SSP Circuit Breaker)	4 A (AMS-02 Fuse)	28 V

AMS-02 System Wire Sizing and Circuit Protection Table

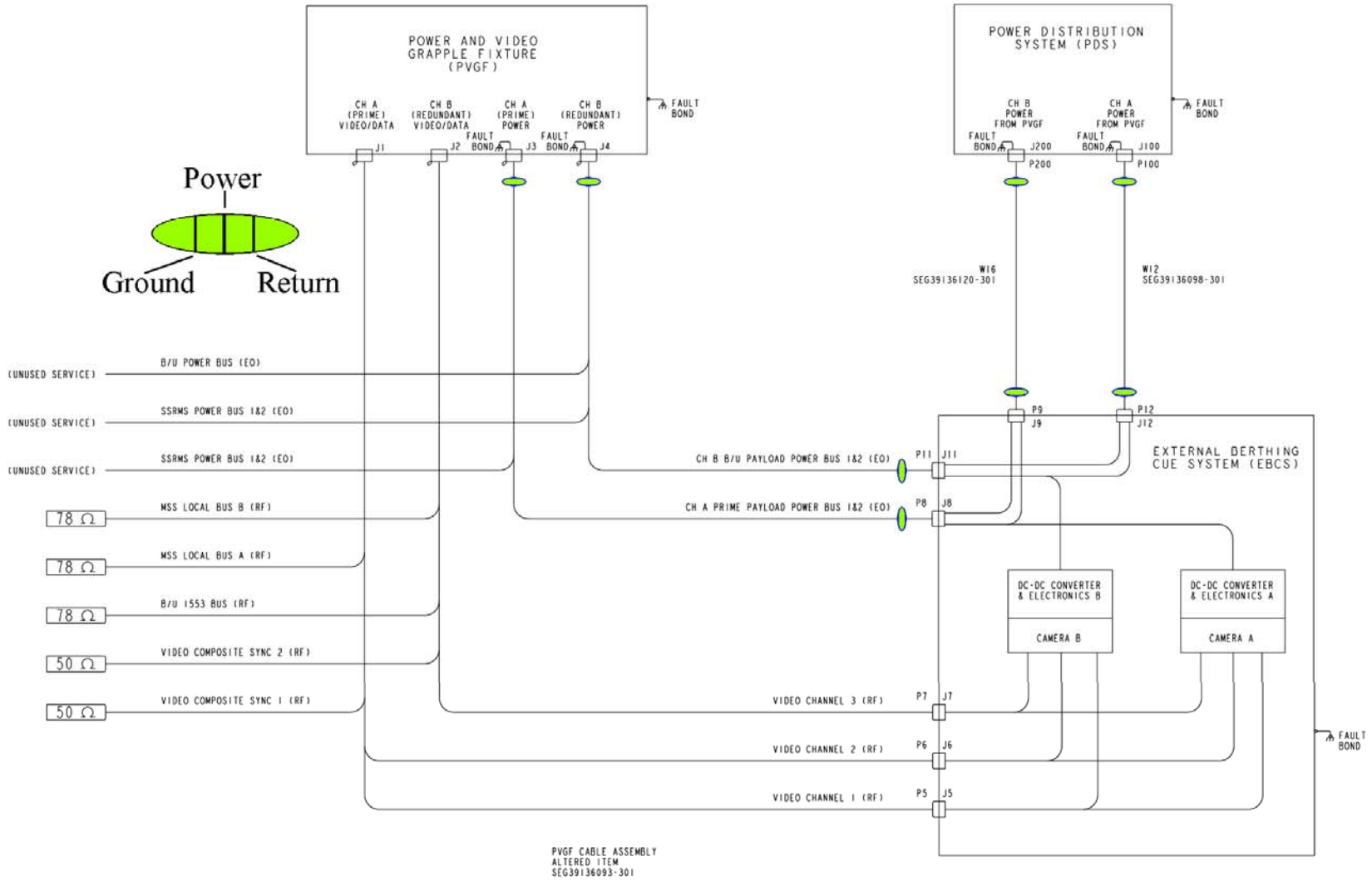
Application	Wire Gauge	Nominal Current	Circuit Protection Type	Threshold Circuit Protection Value
		TBS		



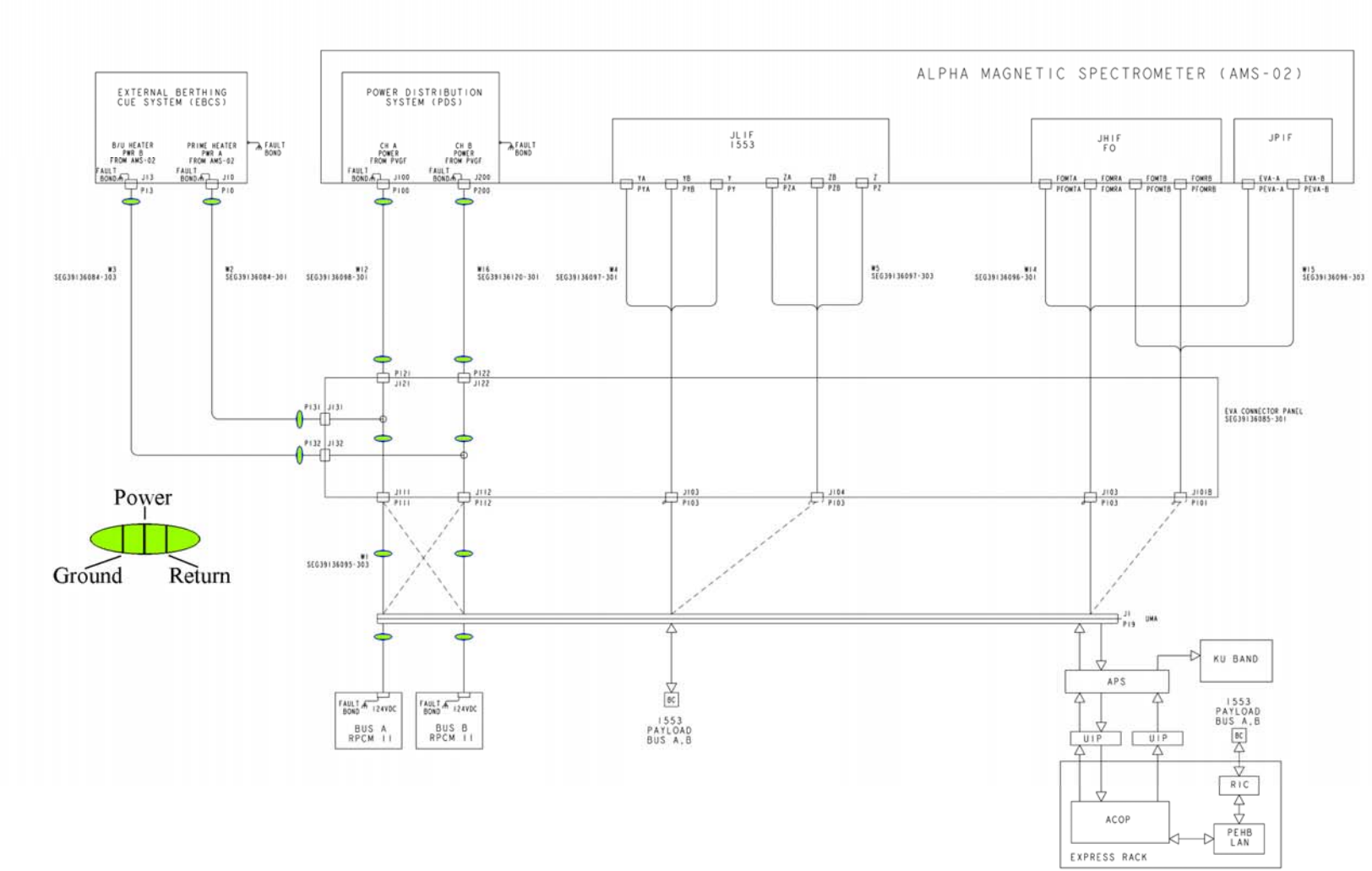
AMS-02 Interface Diagram to T-0 Line



AMS-02 Interface Diagram to STS



AMS-02 Interface Diagram to ISS SSRMS



AMS-02 Interface Diagram to ISS at PAS Location S3